UNIVERSITI PUTRA MALAYSIA

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KAW ZAY YA.

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By

KYAW ZAY YA

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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Dedicated to My Beloved Parent and Teachers

Abstract of thesis submitted to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Doctor of Philosophy

PROTEIN-HYDROCOLLOIDS INTERACTIONS IN "KEROPOK LEKOR"

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KYAW ZAY YA

May 2004

Chairman: Professor Jamilah Bakar, Ph.D.

Faculty : Food Science and Biotechnology

Basic formulation of 'keropok lekor' was developed through a sensory evaluation exercise. A fish to starch ratio of 3:2 and a ratio of sago to tapioca starch of 3:1 were found to be the best formulation. The optimum levels of salt and sugar in the formulation were 2.5% and 3.8%, based on total weight of fish and starch, respectively. Effect of selected hydrocolloids i.e. xanthan, carrageenan and locust bean gums at 0,1,2, and 3% of incorporation on acceptability, structure stability and shelflife of 'keropok lekor' was also studied. Incorporation of 2% locust bean gum significantly increased the sensory acceptability and structure stability of final product. The shelf life of the 'keropok lekor' gel was also enhanced by the incorporation of 2% locust bean gum by 4 day.

Addition of all the hydrocolloids increased gelatinization temperatures of sago starch by 4-6°C and decreased the enthalpy (ΔH) of the gelatinization by 0.5 to 2.3J/g. The ΔH of gelatinization of sago starch with the addition of xanthan

gum was significantly lower than that containing locust bean or carrageenan gums. The starch gelatinization enthalpy (ΔH) of the dough containing locust bean gums was the highest among the hydocolloids.

The effects of the hydrocolloids on hardness of gel and viscoelastic properties of 'keropok lekor' dough were significantly ($P<0.05$) dependent on the water binding ability of the gel. The maximum value of loss (G") and storage (G') moduli of mixtures of locust bean-starch and carrageenan-starch increased with the concentration of the gum. However, these moduli decreased in the xanthan gum-starch mixture. The G' of the 'keropok lekor' dough containing 1% and 2% of locust bean and carrageenan gum were higher than that of control and xanthan gum incorporated in the temperature range of fish protein denaturation (from 30 to 76°C). In doughs with 3% incorporation of hydrocolloids, the G' of the dough incorporated with xanthan gum was found to be the highest. However the peak modulus (G') at gelatinization temperature (86.2°C) of 3% xanthan gum was much lower than that of others. Thus, the textural properties of the 'keropok lekor' incorporated with 3% xantan gum were the lowest among the samples.

Examination of the microstructure by light (LM), scanning electron (SEM) and transmission electron (TEM) microscopy indicated that there were interactions between starch, fish protein, and hydrocolloids. The results from SEM studies showed that the sizes and number of cavities were reduced in 'keropok lekor' incorporated with locust bean and carrageenan gum. Thus, carrageenan and locust bean gums increased the textural properties such as hardness, cohesiveness and springiness of 'keropok lekor'. In contrast, xanthan gum disrupted the protein networking in the 'keropok lekor' gel, and caused the formation of larger size cavities as observed in SEM, and reduced the size of swollen starch granule in the gel matrix as observed in light micrograph. As a result, xanthan gum significantly decreased the hardness, cohesiveness and springiness of 'keropok lekor'. Among the 3 hydrocolloids evaluated in the present study, locust bean gum was the most effective in increasing the water-binding ability and viscoelastic properties, and it decreased the sizes and numbers of the cavities in the gel that influenced the textural characteristics of the final product. Xanthan gum interfered with the gelation process and significantly decreased the viscoelastic properties of the product.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

INTERAKSI PROTIN-HIDROKOLOIDS DALAM KEROPOK LEKOR

Oleh

KYAW ZAY YA

Mei 2004

Pengerusi: Profesor Jamilah Bakar, Ph.D.

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Formulasi asas keropok lekor telah dikenalpasti melalui ujian deria. Nisbah 3:2 kandungan ikan kepada kanji dan 3:1 sagu kepada tepung ubikayu telah dipilih sebagai formulasi yang terbaik. Paras optimum garam dan gula dalam formulasi tersebut adalah 2.5% dan 3.8% berdasarkan berat keseluruhan ikan dan kanji. Kesan penambahan 1, 2 dan 3% hidrokoloid gam xantan, karaginan dan kacang lokus ke atas penerimaan dan kestabilan struktur dan jangka hayat keropok lekor juga telah dikaji. Kajian menunjukkan bahawa darjah penerimaan dan kestabilan struktur produk yang telah digoreng meningkat dengan ketara dengan penaubahan 2% kacang lokus. Hayat simpan keropok mentah juga bertambah dengan ketara dengan penambahan 2% kacang lokus.

Penambahan kesemua hidrokoloid menyebabkan suhu penggelatinan kanji sagu bertambah sebanyak 4-6°C sementara entalpi (ΔH) pula berkurangan di antara 0.5 hingga 2.3J/g. Entalpi (ΔH) penggelatinan kanji sagu ditambah gam xantan adalah lebih rendah daripada kanji sagu yang mengandungi

kacang lokus atau karaginan. Entalpi (ΔH) penggelatinan kanji dalam doh yang mengandungi gam kacang lokus adalah yang tertinggi.

Kesan hidrokoloid ke atas kekerasan gel dan sifat viskoelastik doh keropok lekor secara ketara ($P<0.05$) bergantung kepada keupayaan gel mengikat air. Nilai maksimum modulus hilangan (G") and modulus storan (G') campuran kacang lokus-kanji dan karaginan-kanji meningkat dengan pertambahan kepekatan gam. Walau bagaimanapun, kedua-dua nilai tersebut menurun dalam campuran gam xantan-kanji. G' doh keropok lekor yang mengandungi 1 dan 2% kacang lokus dan karaginan adalah lebih tinggi berbanding dengan kawalan dan doh yang mengandungi gam xantan pada suhu di antara 30°C hingga 76°C penyahasliani protein ikan. Doh mengandungi 3% hidrokoloid, modulus storan (G') bagi doh yang dicampur dengan gam xantan menunjukkan bacaan yang tinggi dibandingkan dengan sampel-sampel yang lain. Doh yang mengandungi 3% gam xantan menunjukkan modulus G' yang tertinggi dalam kumpulan yang sama. Bagaimananpun, modulus storan (G') tertinggi pada suhu pembentukan gelatin (86.2°C) oleh 3% gam xantan adalah lebih rendah daripada sampel-sampel yang lain. Sifat tekstur keropok lekor yang mengandungi 3% gam xantan adalah yang terendah dibanding dengan -sampel yang lain.

Kajian mikrostruktur menggunakan mikroskopi cahaya, mikroskopi imbasan elektron (SEM) and "transmission" elektron (TEM) menunjukan tindak-balas diantara kanji, protein ikan dan hidrokoloid. Keputusan kajian SEM menunjukkan bahawa saiz dan bilangan liang berkurangan di dalam keropok lekor yang dicampur dengan gam kacang lokus and karaginan. Oleh itu, gam karaginan and kacang lokus memperbaiki tekstur keropok lekor. Sebaliknya, gam xantan menganggu protein gel keropok lekor dan menyebabkan pembentukan saiz liang yang lebih besar sepertimana telihat melalui SEM, dan pengecilan saiz granul kanji yang kembang dalam matriks gel seperti terlihat di dalam mikroskopi cahaya. Gam xantan mengurangkan secara ketara sifat tekstur keropok lekor.

Di antara ketiga-tiga hidrokoloid yang dikaji, kacang lokus didapati paling berkesan untuk menambah keupayaan mengikat air dan sifat viskoelastik di samping mengurangkan saiz dan bilangan liang pada gel yang mempengaruhi tekstur produk. Gam xantan mengganggu penggelatinan dan mengurangkan secara ketara sifat viscoelastik produk.

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I certify that an Examination Committee met on 22nd May 2004 to conduct the final examination of Kyaw Zay Ya on his Doctor of Philosophy thesis entitled "Protein-hydrocolloids Interactions in Keropok Lekor" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy. The members of the Supervisory Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

KYAW ZAY YA

Date: July 24, 2004

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